TULANE UNIVERSITY
SCHOOL OF MEDICINE LIBRARY

Modern Concepts of Cardiovascular Disease

Published monthly by the AMERICAN HEART ASSOCIATION

50 WEST 50TH STREET, NEW YORK, N. Y.

SEP 8 1938

DR. JAMES G. CARR, Chicago, *Editor*

DR. GILBERT H. MARQUARDT, Chicago, *Associate Editor*

Vol. VII **September, 1938** **No. 9**

THE HEART IN OBESITY

It is a well recognized fact that the obese individual meets the hazards of life with a greater handicap than the individual who maintains a normal body weight. Insurance companies rarely accept obese individuals as standard risks, for their actuarial experience has indicated a reduced life expectancy; the surgeon admits the fact that operative procedures are performed on such patients with considerably increased risk; the physician clearly appreciates the fact that, among obese patients, pneumonia is attended by an abnormally high mortality and that the death rate following trauma is higher than in normal weight groups. One very important reason for these observations is found by careful study of the cardiovascular system of obese persons.

Owing to the fact that much confusion has resulted from use of various terms denoting the same and different conditions by various writers, it is necessary here to enunciate clearly the present day concepts regarding terminology to avert further confusion of the issue. The literature contains terms such as "fatty degeneration," "fatty infiltration," "fatty metamorphosis," "cor adiposum," "adiposity of the heart," and many others.

In obesity, the most appropriate term describing the heart's participation in the process is "adiposity of the heart." This will be discussed in more detail. "Fatty degeneration" is the condition in which fatty change takes place within the cell (cytoplasm) and which generally is conceded to be the result of diminished utilization (oxidation) of the fat normally brought to the cell. This condition is not observed in obesity but occurs in association with conditions such as poisoning due to chloroform and phosphorus, pernicious anemia, leukemia and in the cachexia of carcinoma. Fatty degeneration does not produce cardiac insufficiency.

The conspiracy of several factors adversely affects the heart and circulation in obesity. As obesity develops, an increased deposition of fat occurs in the normal fat depositories of the body. These depots comprise the subcutaneous tissues, the omentum and mesentery, orbits, perirenal spaces, the bone marrow and, to a lesser extent, the connective tissue beneath the epicardium. When excess deposits of fat occur in the subepicardial space, penetration or infiltration of fat into the connective tissues lying between the muscle bundles occurs and, at times, the penetration occurs between the individual muscle fibers but not into the muscle cell. At times, the process of penetration involves the papillary muscles. This status is designated "adiposity of the heart."

Fat commonly is deposited over the base of the heart, over the auriculoventricular groove, around the bases of the great vessels, along the distribution of the coronary vessels, along the interventricular sulci and over the right ventricle, especially along its right border and anterior surface and at the apex. In practically all cases of obesity, more fat is deposited over the right ventricle than over the left. As a rule, the anterior surface is covered by more fat than the posterior surface. A region on the posterior surface of the left ventricle, about half way between the apex and the base is, as a rule, the last to be covered. The subepicardial fat varies between slight increases above normal and extreme deposits which encase the entire heart, sometimes with a thickness of 2 cm.

When the heart becomes encased in fat and when considerable penetration into the musculature of the right ventricle occurs, it is obvious that some impairment of the function of muscle fibers and their nutrition inevitably occurs. Thus, a local mechanical handicap to the heart itself results.

Another factor that is active in obesity is the increased work imposed upon the heart by the increase in body weight. Smith, in 1928, demonstrated the fact that a definite correlation existed between the weight of the heart and the weight of the body; the ratio for males is 0.43 per cent and that for females 0.4 per cent. In obesity, the weight of the heart parallels the weight of the body up to a level where body weight becomes tremendously increased. Here, the increase in the weight of the heart lags behind that of the body; thus, the weight of the

ANNOUNCEMENT!

For the benefit of those who wish to save current issues of the "Modern Concepts of Cardiovascular Disease," we have had designed a handsome loose-leaf binder, in green fabrikoid with gold stamping, which will accommodate fifty issues. The price is $1.00, postpaid.

Orders with remittances should be mailed to the American Heart Association, 50 West 50th Street, New York, N. Y.

heart, according to the normal correlations, probably becomes inadequate. This, undoubtedly, is a factor in the evident circulatory inadequacy which is demonstrated so frequently when marked degrees of obesity exist. If necropsy is performed, it is found that the size of the heart is not sufficient for bodily needs in approximately a fourth of the cases examined.

Another active factor is one that too frequently is ignored. It was once believed that adipose tissue was a passive structure with relatively inadequate blood supply. It is now known that the blood supply of adipose tissue is marked and that a small capillary lies between nearly every two fat cells. When we visualize the fact that, in obesity, the amount of excess adipose tissue at various sites in the body is greatly increased and, when we appreciate the fact that the surface of the body increases greatly, we are in a position to realize how vastly the circulatory periphery extends itself. This status undeniably imposes greater work on the heart. A further influence predisposing to increased work of the heart among these individuals is the increase in total metabolism that is associated with obesity.

There are no symptoms which characterize adiposity of the heart. The most frequent symptom, however, is dyspnea occurring with accustomed effort. This signal of cardiac embarrassment is ignored too frequently and, being indifferently ascribed to the increased body weight alone, the real import of its presence is overlooked.

Smith and Willius studied 136 hearts of obese patients; the specimens were obtained at necropsy. It seems desirable that a summary of the significant findings resulting from that investigation be emphasized in this discussion. The patients died owing to a great variety of causes and the only basis of selection of the cases included rested solely on the indisputable existence of obesity. We insisted upon an excess in body weight of 13 per cent or more; the computations were made by use of standard actuarial charts on the basis of age, sex, height, and body weight. The minimal excess of body weight was 13 per cent (9.1 kg.), the maximal excess 170 per cent (157.3 kg.), and the average 45 per cent (32.3 kg.). The age of the patients ranged from ten months to seventy-five years; three children were included in the study.

This study demonstrated the fact that adiposity of the heart alone is occasionally capable of producing congestive heart failure. In 7 per cent of the cases, no evidence of associated cardiac disease was demonstrable and recent or preexistent hypertension was definitely excluded. These patients represented extreme examples of obesity, the average excess of body weight was 60 per cent (20.5 kg.).

However, in more than half the cases (55 per cent), such diseases as hypertension, coronary sclerosis, healed valvular defects, and so forth were present and it appeared that heart failure when present, in most instances was induced by the added burden of these associated cardiac diseases on a cardiovascular system already overtaxed by the penalties of obesity. In 38 per cent of the series, adiposity of the heart uncomplicated by other forms of heart disease and unassociated with congestive heart failure occurred.

The average age of these obese patients at death was only 52.1 years, confirming the actuarial data that the life expectancy in obesity is unfavorable. There were approximately twice as many women as men.

Attesting to the increased surgical risk encountered among obese patients, it was found that 19 per cent of the series suffered fatal pulmonary embolism. The tendency to circulatory inadequacy among obese patients, already emphasized, is undoubtedly contributory to the relatively high incidence of this fatal complication. Hypertension occurred in 44 per cent of the cases. Death, wholly attributable to heart failure, occurred in 14 per cent of the entire series.

With the foregoing facts in mind, it is evident that the hazards of obesity are realities. The problem of management and treatment is chiefly concerned with prevention of obesity and, therefore, prevention of adiposity of the heart. Judicious weight reduction, when obesity exists, is indicated. Frequently, however, normal or even relatively normal body weight cannot be attained so that the results from this management are only partially fulfilled. Restriction of physical activity is frequently necessary, especially if cardiac embarrassment is a prominent feature and, here again, reduction of body weight encounters an obstacle. When congestive heart failure supervenes, management of the patient is carried out according to the accepted tenets of treatment of heart failure under other conditions.

Summary and Conclusions

Among obese individuals, embarrassment of the heart and circulation is prone to occur owing to the following reasons:

1. An excess amount of fat is deposited within and outside the normal fat depositories of the body. One of these depositories is the connective tissue beneath the epicardium. When this fat depot becomes overwhelmed, adipose tissue may encase the heart partially or completely and penetrate into the musculature of the heart. This penetration occurs between the muscle bundles and, at times, between the muscle fibers, but not into the muscle cell. The right ventricle always is involved to a greater extent than the left ventricle. This status impairs the function and nutrition of the myocardium.

2. The increase in body weight increases the work of the heart through the extravagance of physical activity.

3. The increase in adipose tissue throughout the body and the increase of body surface associated with obesity require a tremendous extension of the arterial periphery which, in turn, imposes greater work on the heart.

4. The total metabolism among obese individuals is accelerated, another factor in increasing the work of the heart.

References

1. Smith, H. L.: The relation of the weight of the heart to the weight of the body, and of the weight of the heart to age. Am. Heart Jour. 4:79-93 (Oct.) 1928.

2. Smith, H. L. and Willius, F. A.: Adiposity of the heart: a clinical and pathologic study of 136 obese patients. Arch. Int. Med. 52:911-931 (Dec.) 1933.

Fredrick A. Willius, M.D.
Rochester, Minnesota